CLAIMS

[C001] A method of controlling ignition of a main fuel in an internal combustion engine having at least one cylinder having a combustion chamber, the method comprising:

diverting a portion of the main fuel to a processing system;

processing said portion of the main fuel to increase ignition sensitivity thereof and form a pilot fuel;

introducing the main fuel into the combustion chamber; and

introducing said pilot fuel to control ignition of the main fuel.

[C002] The method of claim 1 wherein the main fuel is injected with a symmetry line of spray at an angle with respect to a diameter of the combustion chamber, the angle being sufficiently large so that a substantial amount of the main fuel is intermixed with cylinder charged air prior to combustion.

[C003] The method of claim 1 wherein the main fuel is diesel fuel.

[C004] The method of claim 1 wherein said processing includes processing heavier hydrocarbons of said portion of the main fuel to generate said pilot fuel having lighter hydrocarbons.

[C005] The method of claim 1 wherein the engine is a homogeneous charge combustion injection (HCCI) engine.

[C006] The method of claim 1 wherein the main fuel is introduced prior to introducing said pilot fuel.

[C007] The method of claim 6 wherein when said pilot fuel is introduced, said main fuel is part of a compressed main charge and said pilot fuel is immediately ignited upon entry into the combustion chamber heated by compression creating a pilot flame to ignite said main charge.

[C008] The method of claim 1 wherein said pilot fuel is mixed with the main fuel forming a mixed main charge at a selected time prior to combustion in a manner to regulate said main charge chemistry to control ignition properties thereof.

[C009] The method of claim 1 wherein the main fuel has a cetane number between about 5 to about 35, while said pilot fuel has a cetane number between about 40 to about 60.

[C010] The method of claim 1 wherein said pilot fuel is less than about 7% while the main fuel is greater than about 93% of the total volume of fuel ignited in the combustion chamber.

[C011] The method of claim 1 wherein said processing said portion of the main fuel to increase ignition sensitivity thereof forming a pilot fuel includes one of reforming; catalytic processing; or partial oxidation combustion.

[C012] A method of controlling ignition of a main fuel in an internal combustion engine having at least one cylinder having a combustion chamber, the method comprising:

diverting a portion of the main fuel to a processing system, wherein the main fuel comprises a diesel fuel;

processing said portion of the main fuel to increase ignition sensitivity thereof and form a pilot fuel;

injecting the main fuel into the combustion chamber with a symmetry line of spray at an angle with respect to a diameter of the combustion chamber, the angle being sufficiently large so that a substantial amount of the main fuel is intermixed with cylinder charged air prior to combustion; and

introducing said pilot fuel to control ignition of the main fuel.

[C013] The method of claim 12 wherein the engine is a homogeneous charge combustion injection (HCCI) engine and wherein said processing includes processing heavier hydrocarbons of said portion of the main fuel to generate said pilot fuel having lighter hydrocarbons.

[C014] The method of claim 13 wherein the main fuel is introduced prior to introducing said pilot fuel.

[C015] The method of claim 14 wherein when said pilot fuel is introduced, said

main fuel is part of a compressed main charge and said pilot fuel is immediately ignited upon entry into the combustion chamber heated by compression creating a pilot flame to ignite said main charge.

[C016] The method of claim 13 wherein said pilot fuel is mixed with the main fuel forming a mixed main charge at a selected time prior to combustion in a manner to regulate said main charge chemistry to control ignition properties thereof.

[C017] The method of claim 13 wherein the main fuel has a cetane number between about 5 to about 35, while said pilot fuel has a cetane number between about 40 to about 60.

[C018] The method of claim 13 wherein said pilot fuel is less than about 7% while the main fuel is greater than about 93% of the total volume of fuel ignited in the combustion chamber.

[C019] The method of claim 13 wherein said processing said portion of the main fuel to increase ignition sensitivity thereof forming a pilot fuel includes one of reforming; catalytic processing; or partial oxidation combustion.

[C020] A control system for controlling ignition of a main fuel in an internal combustion engine having at least one cylinder having a combustion chamber comprising:

a processing system in fluid communication with the main fuel configured for receiving a portion of the main fuel and processing said portion of the main fuel to increase ignition sensitivity thereof and form a pilot fuel;

a main fuel system configured to introduce the main fuel into the combustion chamber; and

a pilot fuel system configured to introduce said pilot fuel to control ignition of the main fuel.

[C021] The control system of claim 20 wherein the main fuel system is configured to inject the main fuel in a manner so that a substantial amount of the main fuel is intermixed with cylinder charged air prior to combustion.

[C022] The control system of claim 20 wherein the main fuel is diesel fuel.

[C023] The control system of claim 20 wherein said processing system includes an in situ processing system configured to process heavier hydrocarbons of said portion of the main fuel and generate said pilot fuel having lighter hydrocarbons.

[C024] The control system of claim 20 wherein the engine is a homogeneous charge combustion injection (HCCI) engine.

[C025] The control system of claim 20 further comprising a fuel system controller configured for controlling the main and pilot fuel systems so that the main fuel is introduced prior to introducing said pilot fuel.

[C026] The control system of claim 25 further comprising a fuel system controller configured for controlling the main and pilot fuel systems so that when said pilot fuel is introduced, said main fuel is part of a compressed main charge and said pilot fuel is immediately ignited upon entry into the combustion chamber heated by compression creating a pilot flame to ignite said main charge.

[C027] The control system of claim 20 further comprising a fuel system controller configured for controlling the main and pilot fuel systems so that said pilot fuel is mixed with the main fuel forming a mixed main charge at a selected time prior to combustion in a manner to regulate said main charge chemistry to control ignition properties thereof.

[C028] The control system of claim 20 wherein the main fuel has a cetane number between about 5 to about 35, while said pilot fuel has a cetane number between about 40 to about 60.

[C029] The control system of claim 20 wherein said pilot fuel is less than about 7% while the main fuel is greater than about 93% of the total volume of fuel ignited in the combustion chamber.

[C030] The control system of claim 20 wherein said processing system configured to process said portion of the main fuel to increase ignition sensitivity thereof forming a pilot fuel further includes one of: a reformer; a catalytic device; or a partial oxidation combustor.

[C031] A control system for controlling ignition of a main fuel comprising diesel fuel in an internal combustion engine having at least one cylinder having a combustion chamber comprising:

a processing system in fluid communication with the main fuel configured for receiving a portion of the main fuel and processing said portion of the main fuel to increase ignition sensitivity thereof and form a pilot fuel;

a main fuel system configured to inject the main fuel into the combustion chamber with a symmetry line of spray at an angle with respect to a diameter of the combustion chamber, the angle being sufficiently large so that a substantial amount of the main fuel is intermixed with cylinder charged air prior to combustion; and

a pilot fuel system configured to introduce said pilot fuel to control ignition of the main fuel.

[C032] The control system of claim 31 wherein the engine is a homogeneous charge combustion injection (HCCI) engine and wherein said processing system includes an in situ processing system configured to process heavier hydrocarbons of said portion of the main fuel and generate said pilot fuel having lighter hydrocarbons.

[C033] The control system of claim 32 further comprising a fuel system controller configured for controlling the main and pilot fuel systems so that the main fuel is introduced prior to introducing said pilot fuel.

[C034] The control system of claim 33 further comprising a fuel system controller configured for controlling the main and pilot fuel systems so that when said pilot fuel is introduced, said main fuel is part of a compressed main charge and said pilot fuel is immediately ignited upon entry into the combustion chamber heated by compression creating a pilot flame to ignite said main charge.

[C035] The control system of claim 31 further comprising a fuel system controller configured for controlling the main and pilot fuel systems so that said pilot fuel is mixed with the main fuel forming a mixed main charge at a selected time prior to combustion in a manner to regulate said main charge chemistry to control ignition properties thereof.

[C036] The control system of claim 31 wherein the main fuel has a cetane number between about 5 to about 35, while said pilot fuel has a cetane number between about 40 to about 60.

[C037] The control system of claim 31 wherein said pilot fuel is less than about 7% while the main fuel is greater than about 93% of the total volume of fuel ignited in the combustion chamber.

[C038] The control system of claim 31 wherein said processing system configured to process said portion of the main fuel to increase ignition sensitivity thereof forming a pilot fuel further includes one of: a reformer; a catalytic device; or a partial oxidation combustor.

[C039] A diesel locomotive internal combustion engine comprising at least two cylinders, each having a reciprocating piston operatively connected to a crank and a combustion chamber, also comprising means for separately injecting a primary main fuel and a high combustion auxiliary pilot fuel into the combustion chambers of an internal combustion diesel engine comprising:

a processing system in fluid communication with the main fuel configured for receiving a portion of the main fuel and processing said portion of the main fuel to increase ignition sensitivity thereof and form the pilot fuel;

a main fuel system configured to introduce the main fuel into the combustion chamber; and

a pilot fuel system to introduce the pilot fuel to control ignition of the main fuel in the diesel locomotive internal combustion engine.